Evaluation of SW Radiance Errors from NB-BB Regression Algorithm

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MOTIVATION

Develop MODIS-CERES narrowband to broadband regressions to convert clear-sky MODIS NB radiances to BB SW radiances which then are used together with CERES ADMs to estimate radiative fluxes for aerosol forcing studies.

Methodology

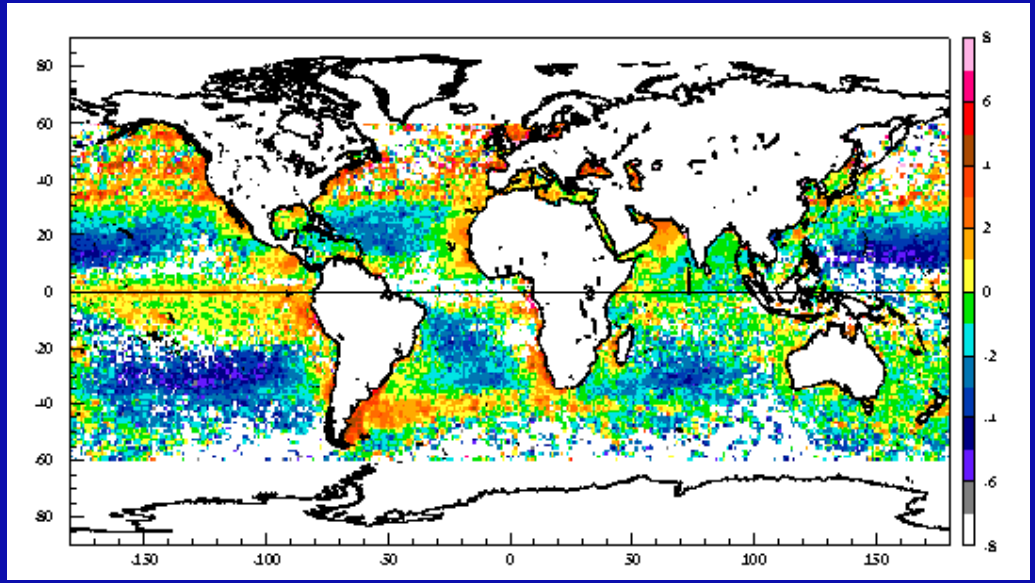
- CERES SSF Data
  - 46 months of CERES-MODIS Terra measurements (3/2000 - 12/2003)
  - Cloud-free broadband FAPS over ocean/land (use CERES cloud mask)
  - MODIS radiances (@ 0.63,1.64,0.86 μm channels) -> clear portion

- Formulation of Regressions
  - multi-channel regression fits

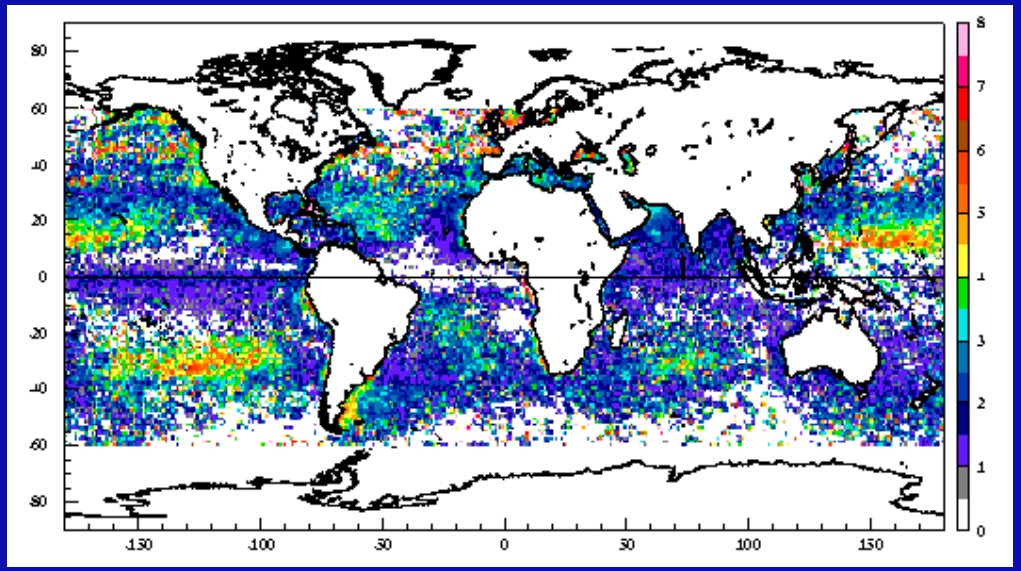
$$I_{sw} = a_o + \sum_{i=1}^{N_\lambda} a_i I_i$$

  - function of viewing geometry -> $\Delta\Theta_0$=10 ^{o}, $\Delta\Theta$=10 ^{o} , $\Delta\Phi$=20 ^{o}
  - monthly sets of regression coefficients to account for seasonal variations.
  - Ocean and Land (forest, savanna, grass/cropland, dark desert, bright desert)

Relative Bias and RMS Error in Ocean SW Radiance for DJF

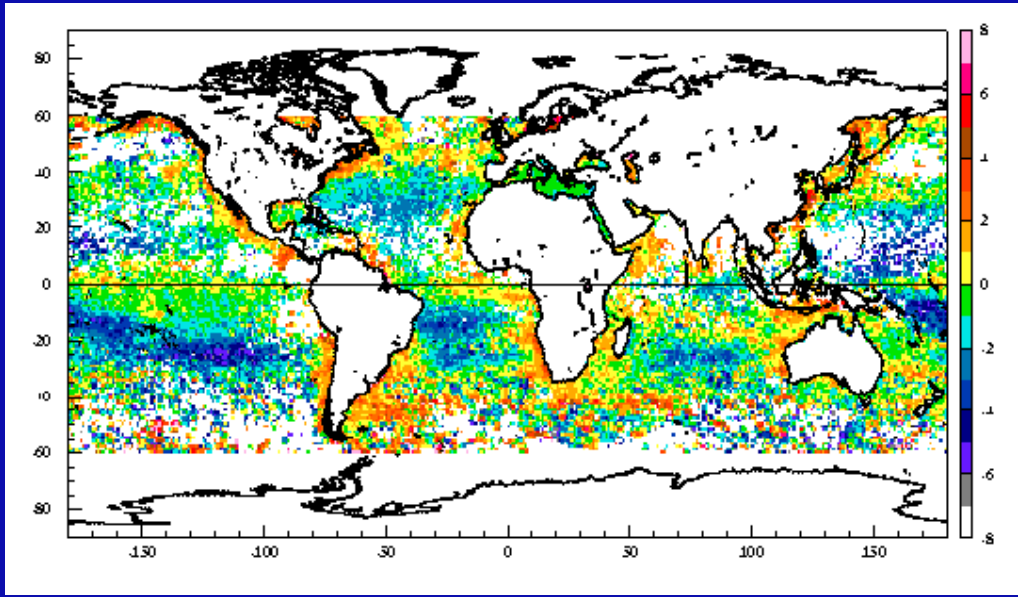


Relative
Bias Error (%)

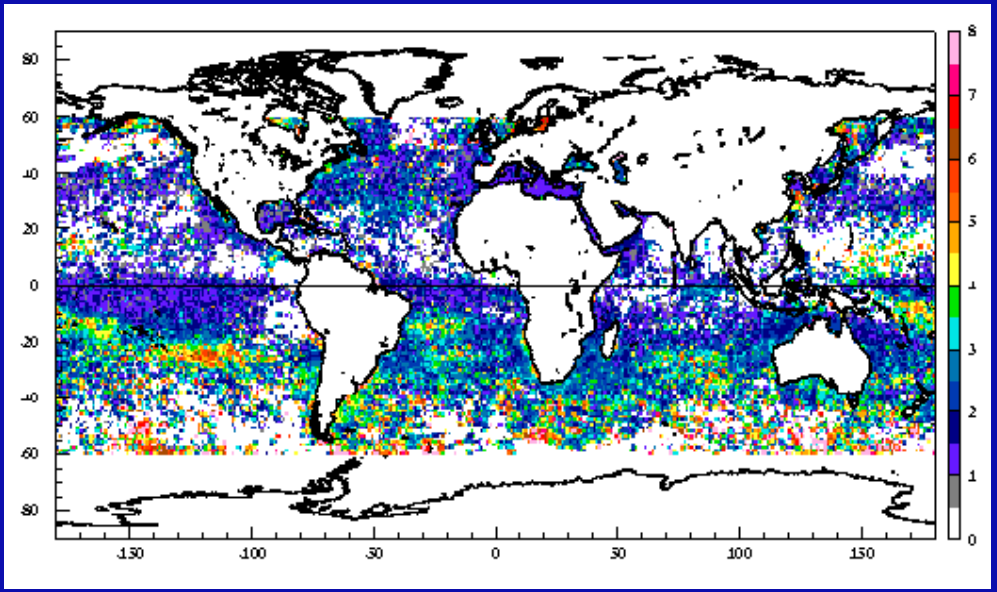


Relative
RMS Error (%)

Relative Bias and RMS Error in Ocean SW Radiance for JJA

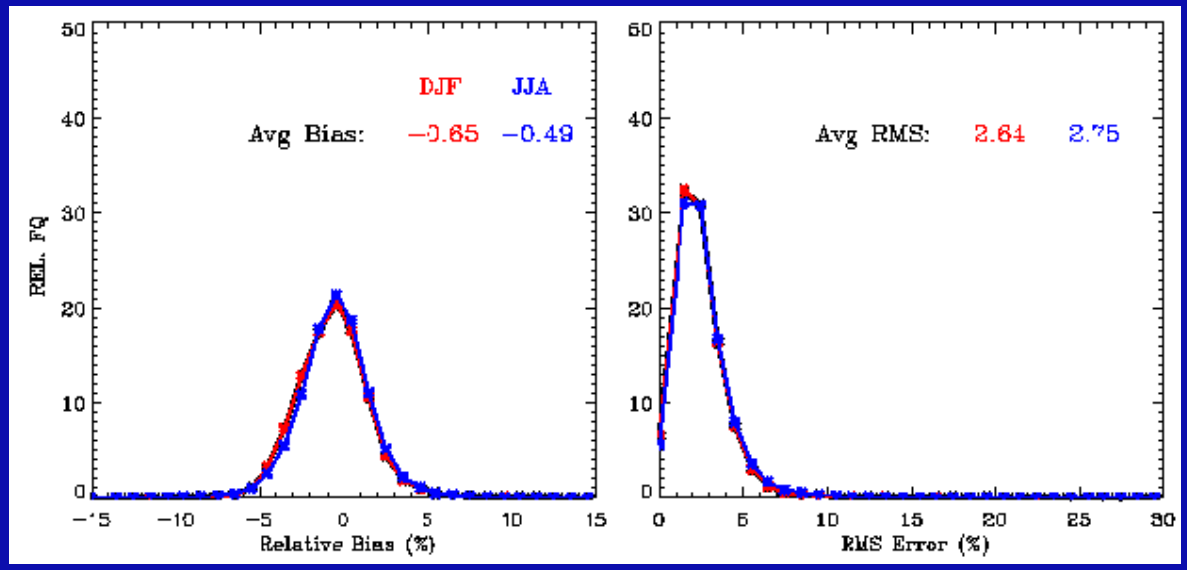


Relative
Bias Error (%)

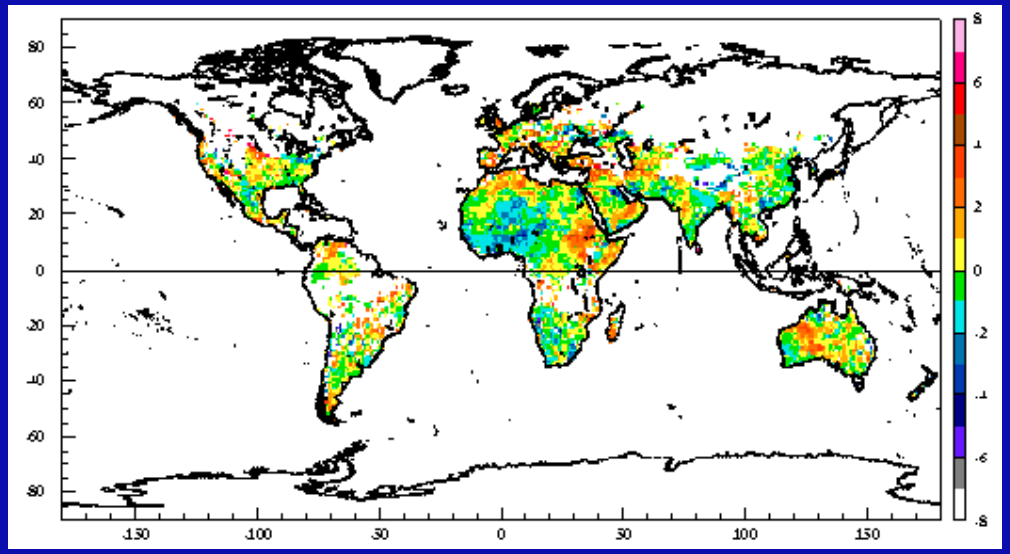


Relative
RMS Error (%)

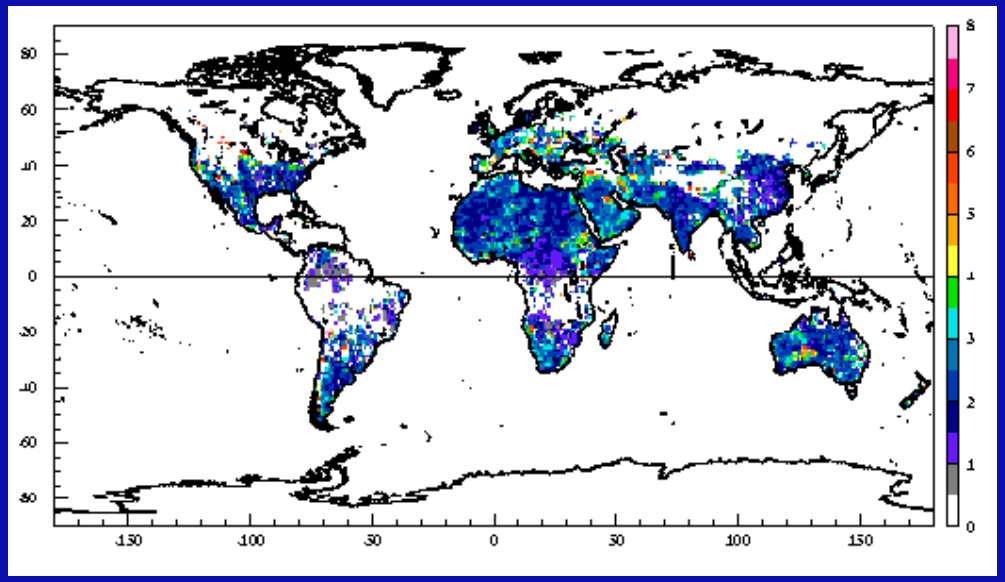
Relative Bias and RMS Error in SW Radiances from NB->BB Regression Fits in 1° x 1° Regions (Ocean) in DJF and JJA



Relative Bias and RMS Error in Land SW Radiance for DJF

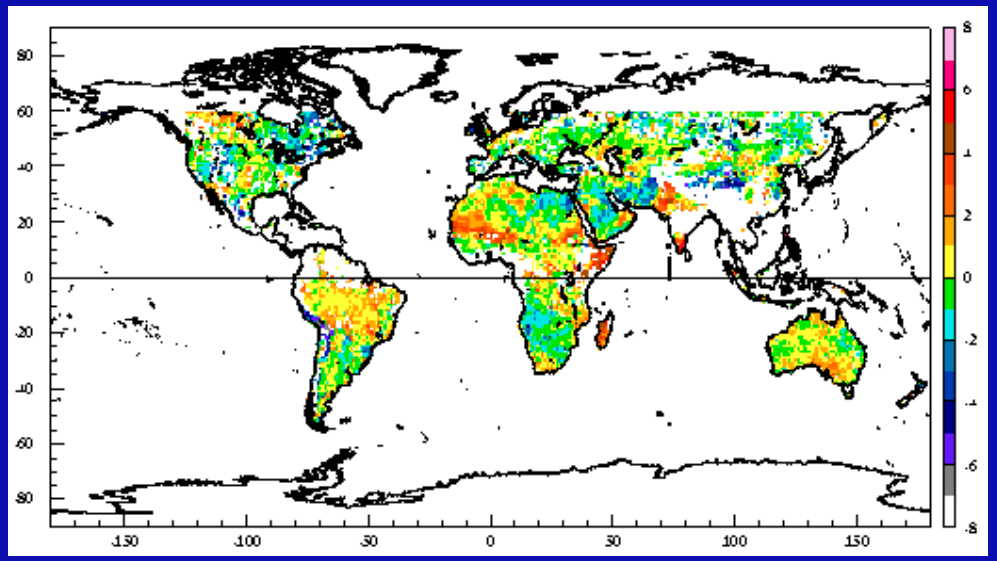


Relative
Bias Error (%)

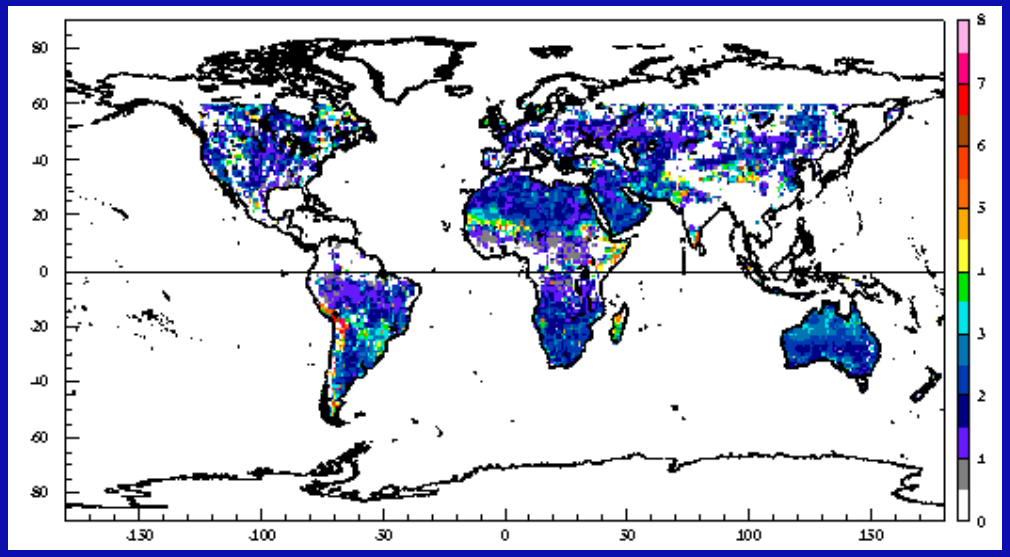


Relative
RMS Error (%)

Relative Bias and RMS Error in Land SW Radiance for JJA

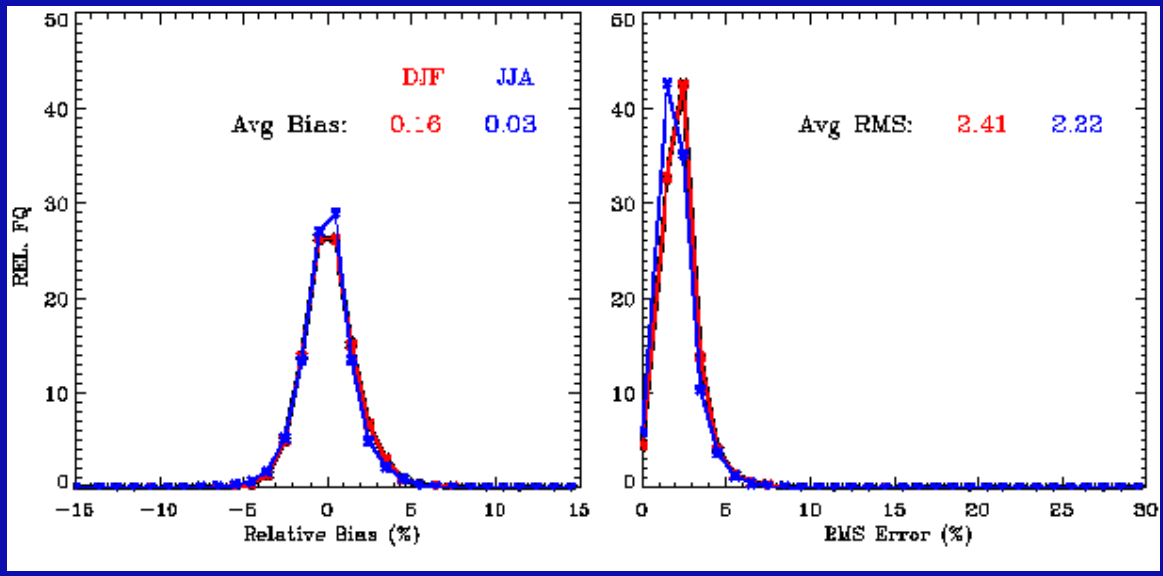


Relative
Bias Error (%)



Relative
RMS Error (%)

Relative Bias and RMS Error in SW Radiances from NB->BB Regression Fits in 1° x 1° Regions (Land) in DJF and JJA



Summary of Results

- MODIS-CERES narrowband-to-broadband regressions are used to convert clear sky MODIS NB radiances to BB SW radiances.
- The uncertainty in the estimated SW radiances are in the order of 2.41% (land) - 2.75%(ocean) after averaging over 1^{o} x 1^{o} latitude-longitude regions.

Comparison of MODIS and MISR Surface Albedo Products

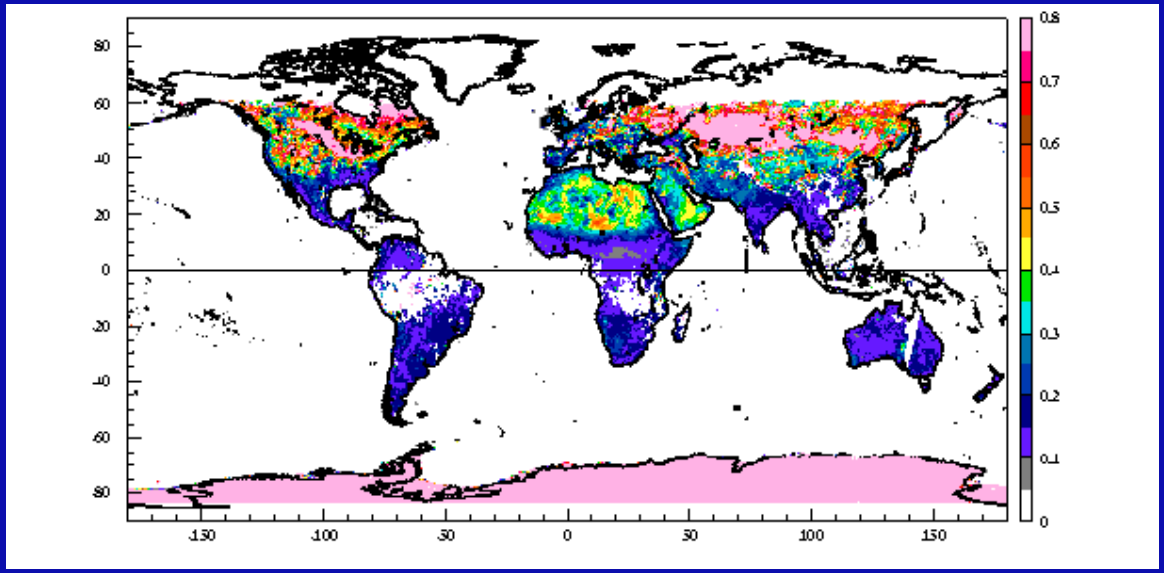
Directional-Hemispherical Reflectance/Black-sky Albedo

Definition: Albedo of the surface in the absence of the diffuse component.

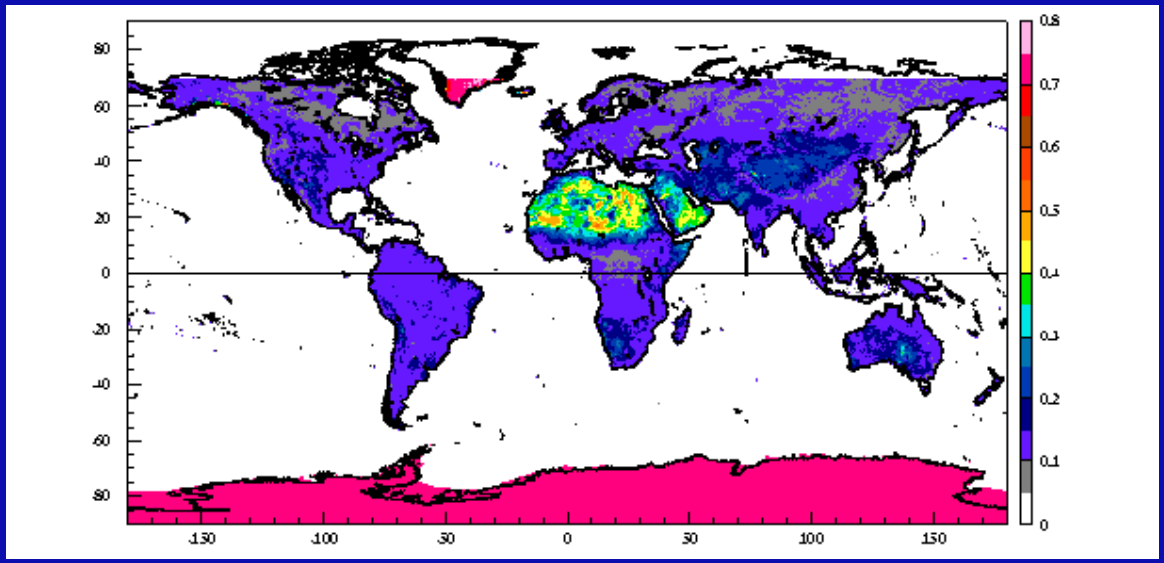
- MODIS (Black-sky albedo)
  - Statistical Product (Filled Land Surface Albedo Product)
    - generated from MOD43B3
  - 16-day period
  - 7 spectral bands (0.47-2.1 μm) and VIS, NIR and SW BB (0.3-5.0 μm)
  - computed at local solar noon
  - uses a "kernel-driven" semi-empirical BRDF model from which BSA is computed

- MISR (Directional-Hemispherical Reflectance)
  - 4 spectral bands (0.44, 0.55,0.67,0.86 μm) and SW BB (0.4-2.5 μm)
  - monthly product (Level 3 - 0.5 deg equal angle grid)
  - uses a parameterized BRDF surface model

Broadband DHR for MODIS/MISR for January 2001

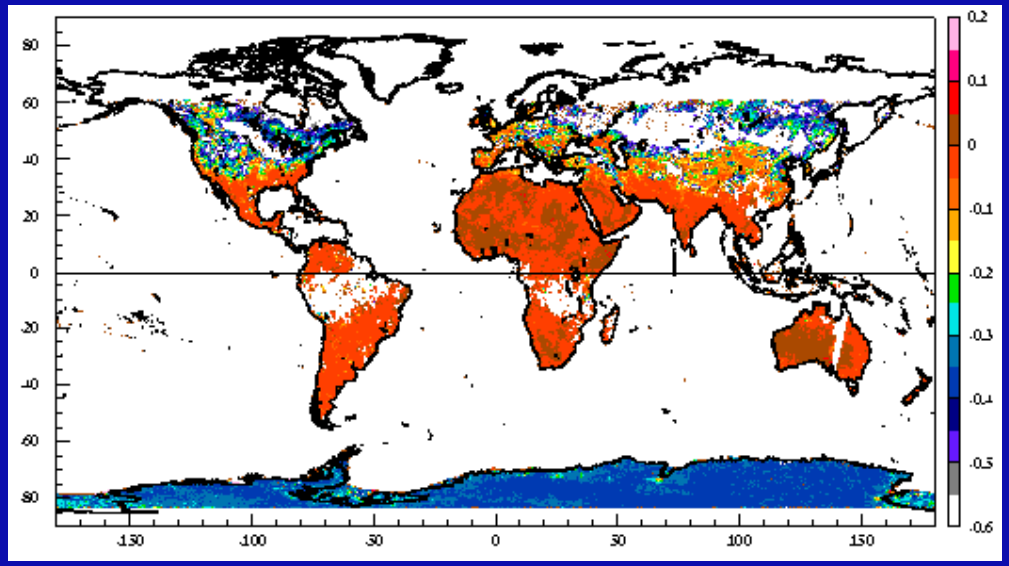


MISR DHR

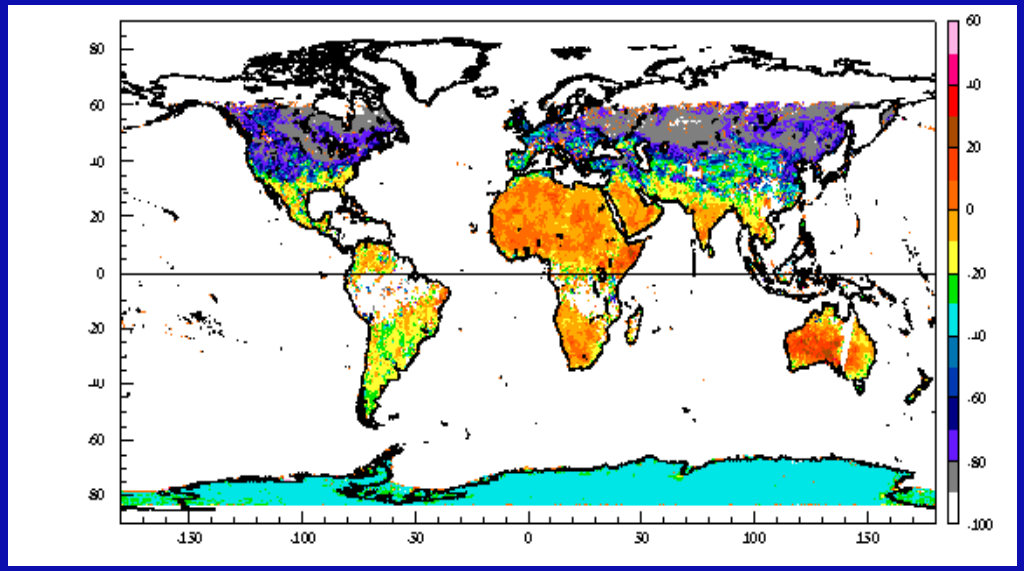


MODIS DHR

Broadband DHR Difference (MODIS-MISR) for January 2001

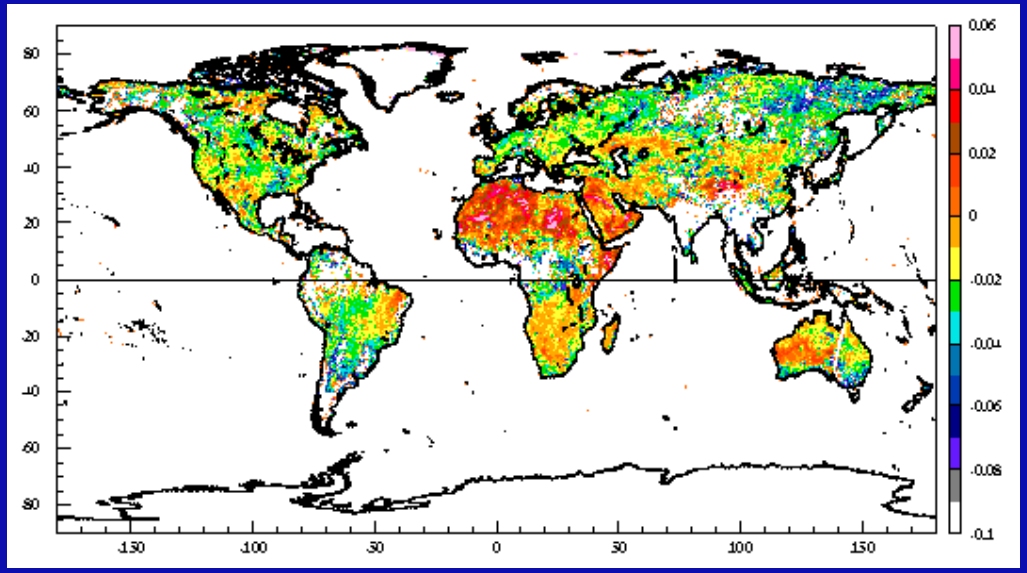


Absolute
ΔDHR

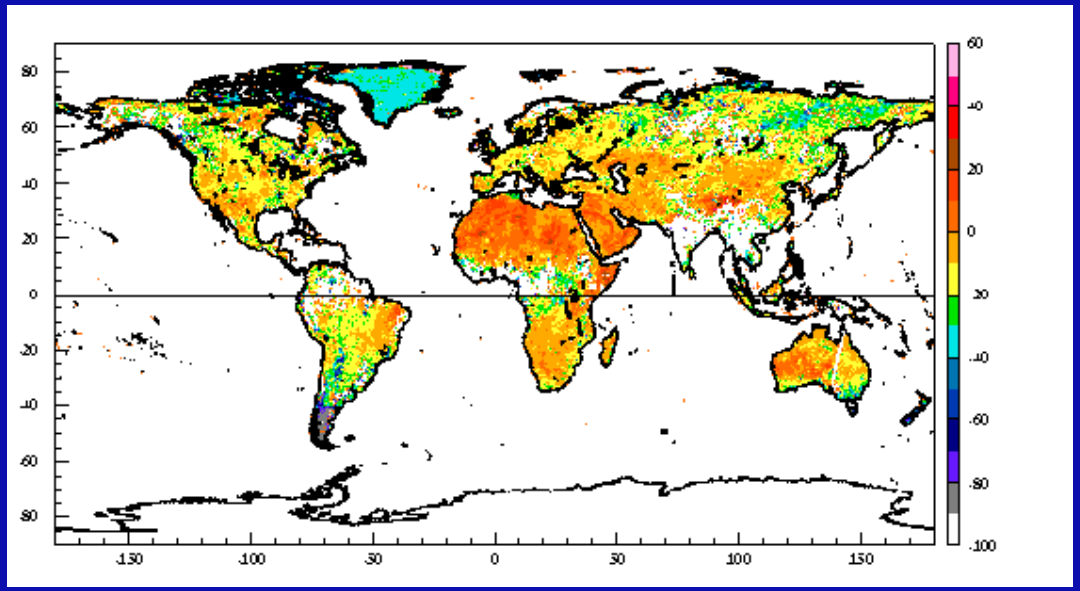


Relative
ΔDHR (%)

Broadband DHR Difference (MODIS-MISR) for July 2001

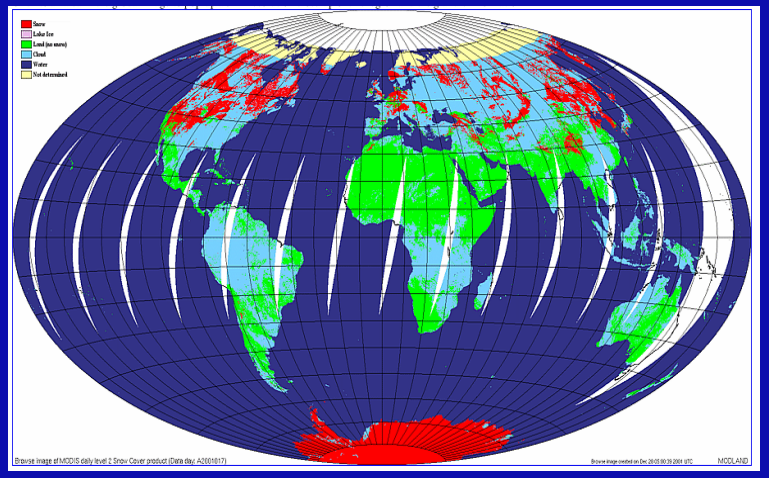


Absolute
ΔDHR

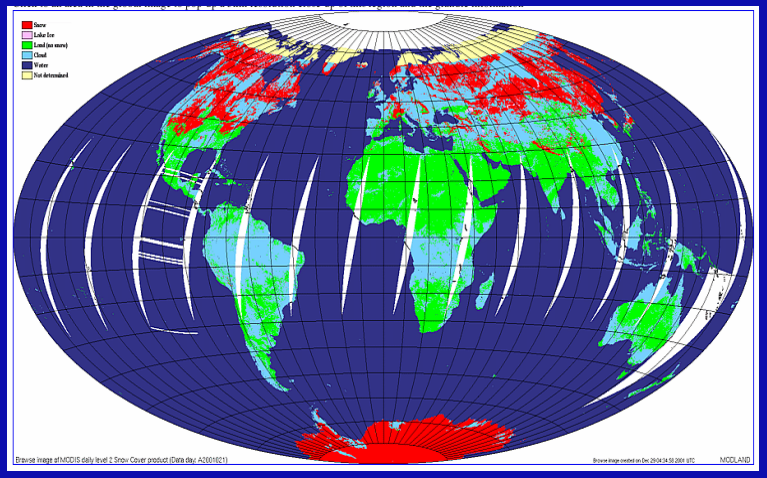


RELATIVE
ΔDHR (%)

MODIS Snow Cover (MOD10) for January 2001



1/17/01



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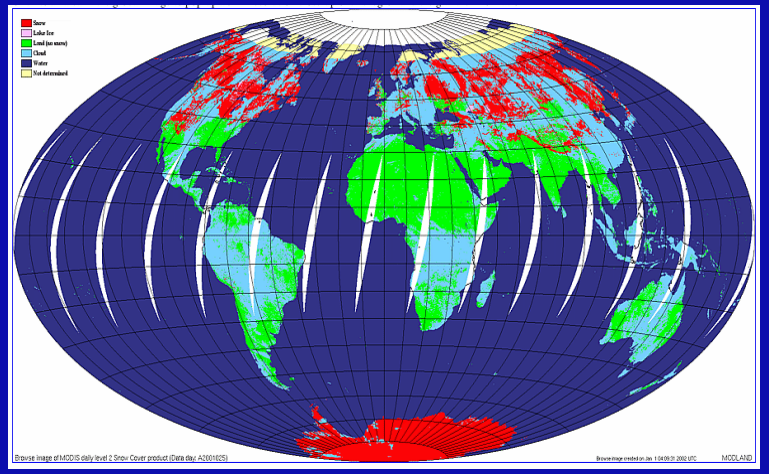

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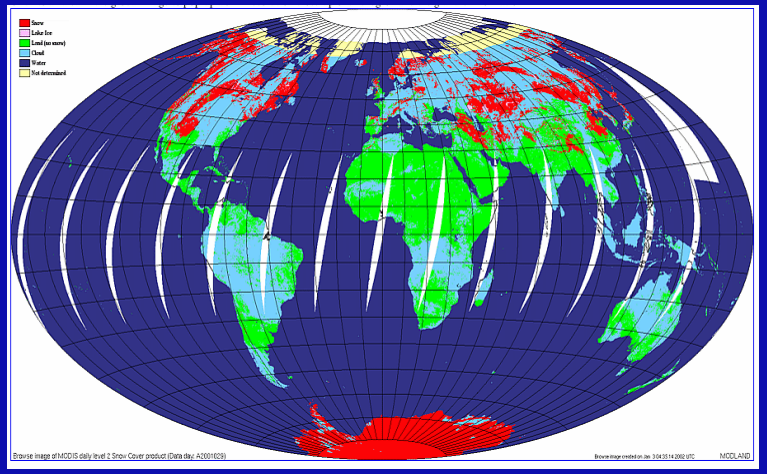
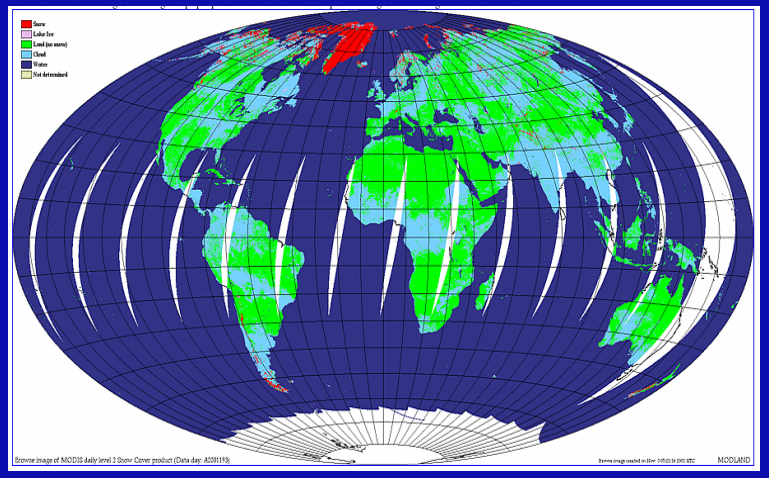
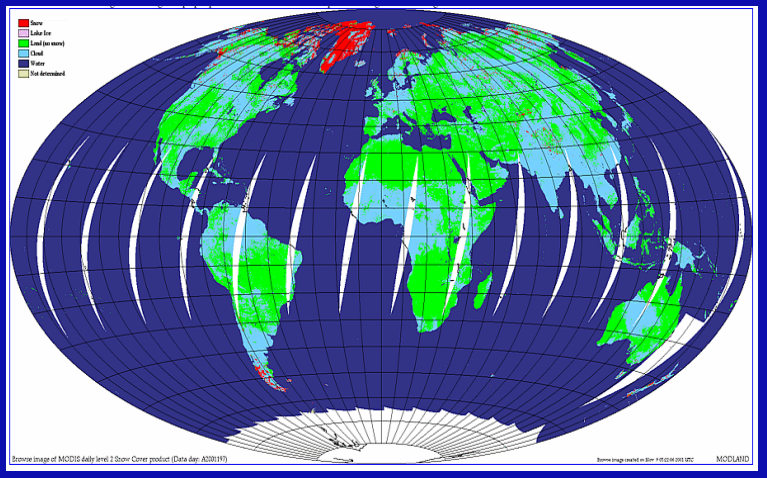


1/29/01

MODIS Snow Cover (MOD10) for July 2001



7/12/01



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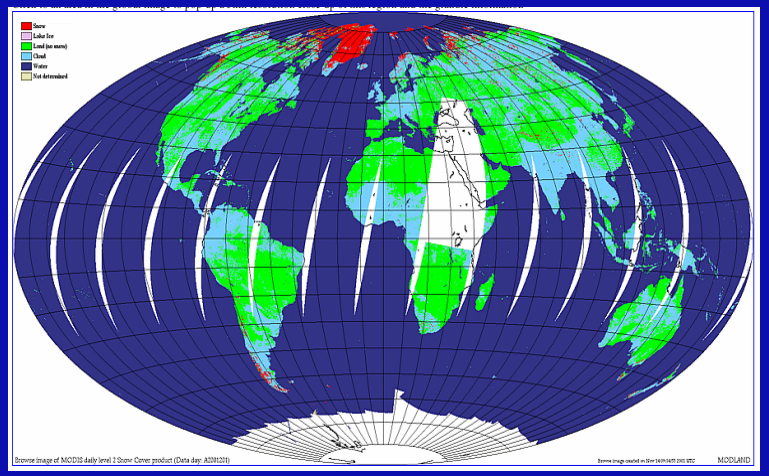
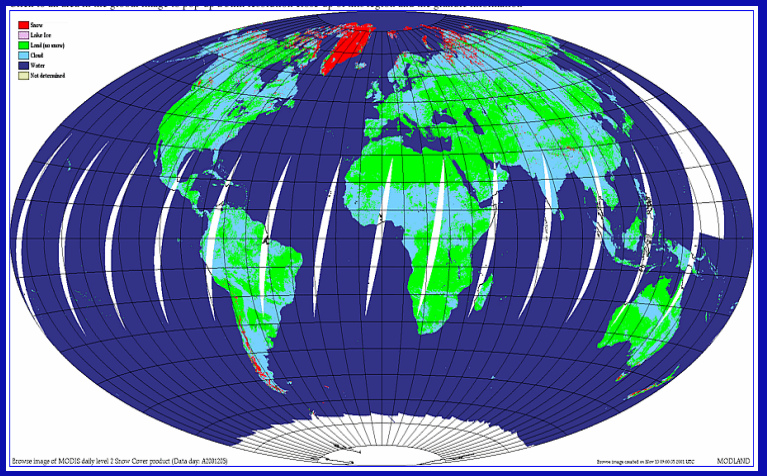


7/20/01



7/23/01

Summary of Results

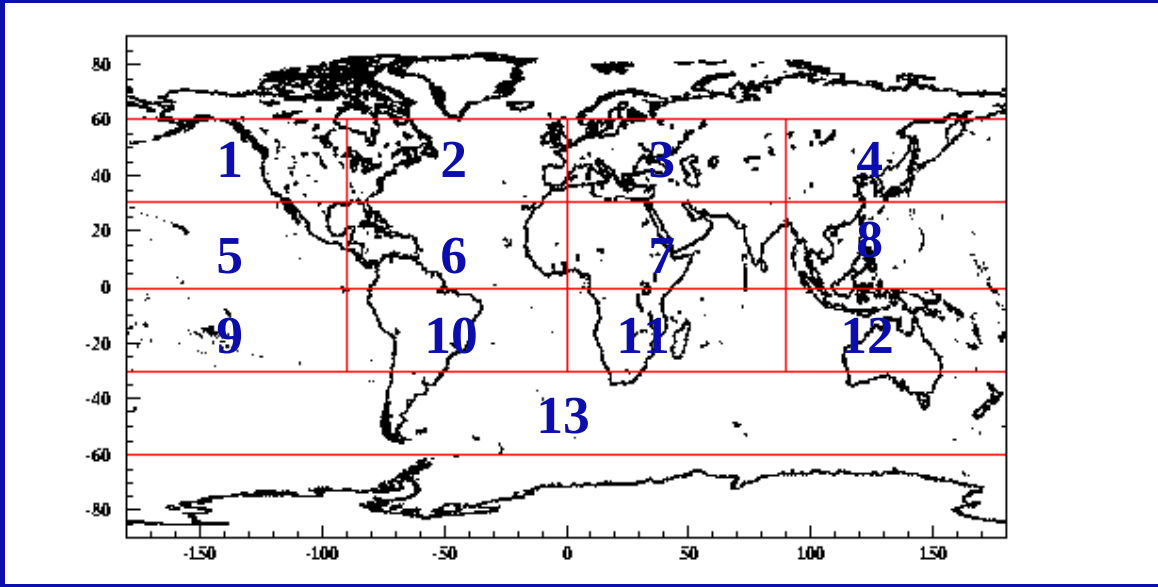
- MISR DHR is generally higher than MODIS BSA
  except for deserts.

- MODIS BSA and MISR DHR are similar in regions with no snow coverage.

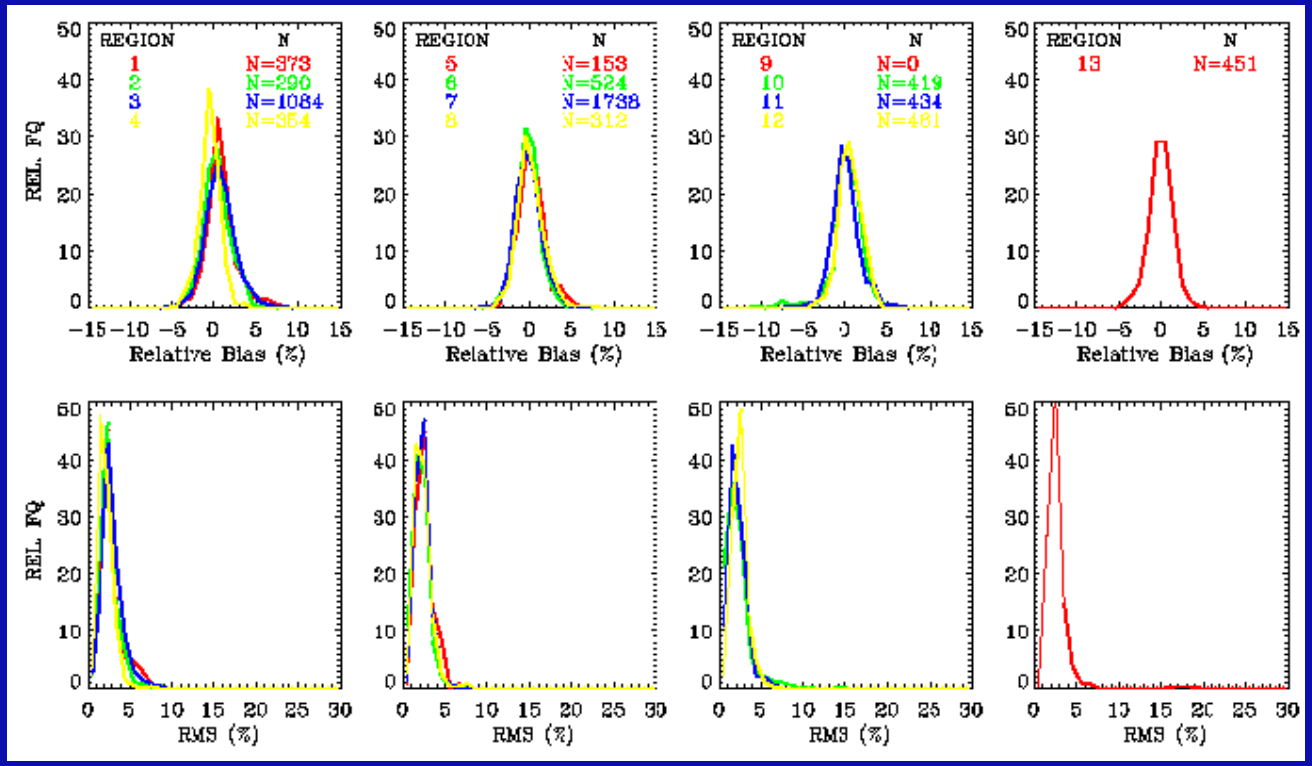
- Need to investigate reasons for differences between albedo products
  - NB->BB conversion techniques (spectral albedo comparisons show same patterns)
  - processing procedures in the presence of snow
  - differences in computation of DHR

BACK-UP SLIDES

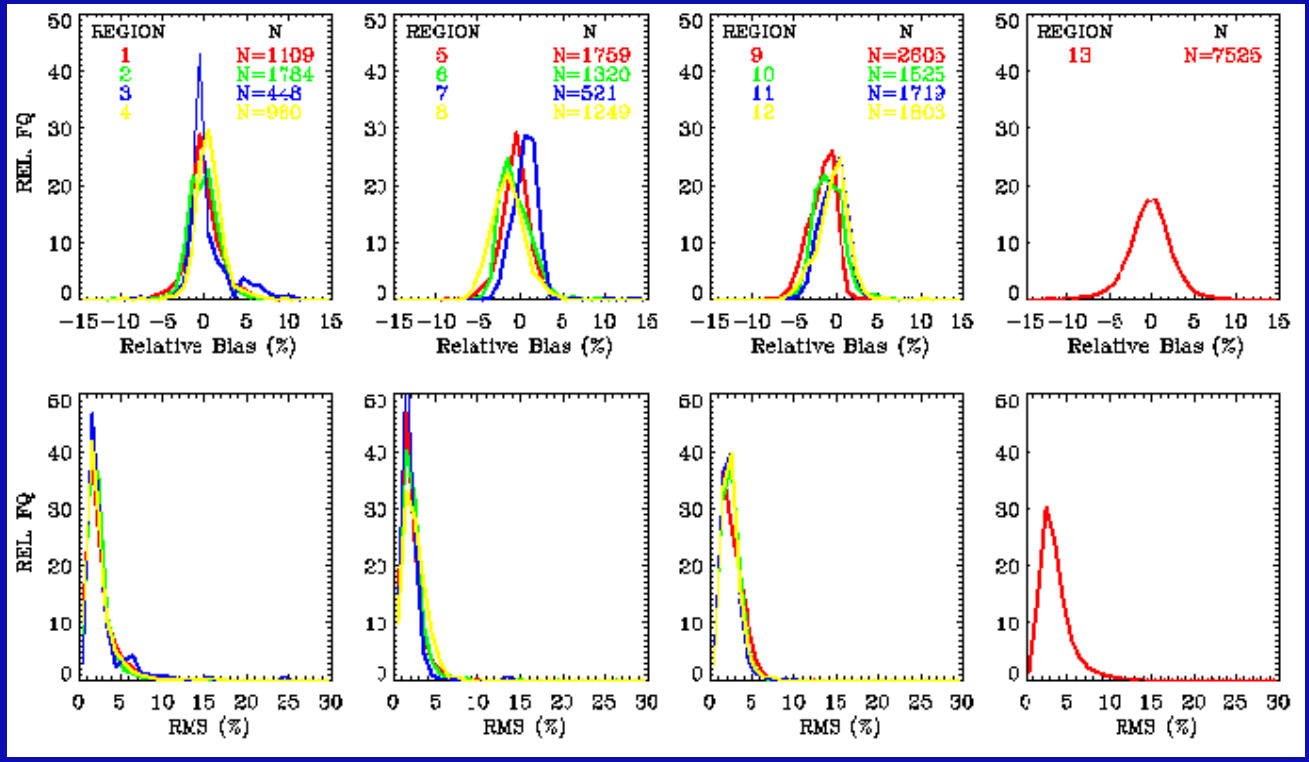
STRATIFICATION BY REGION



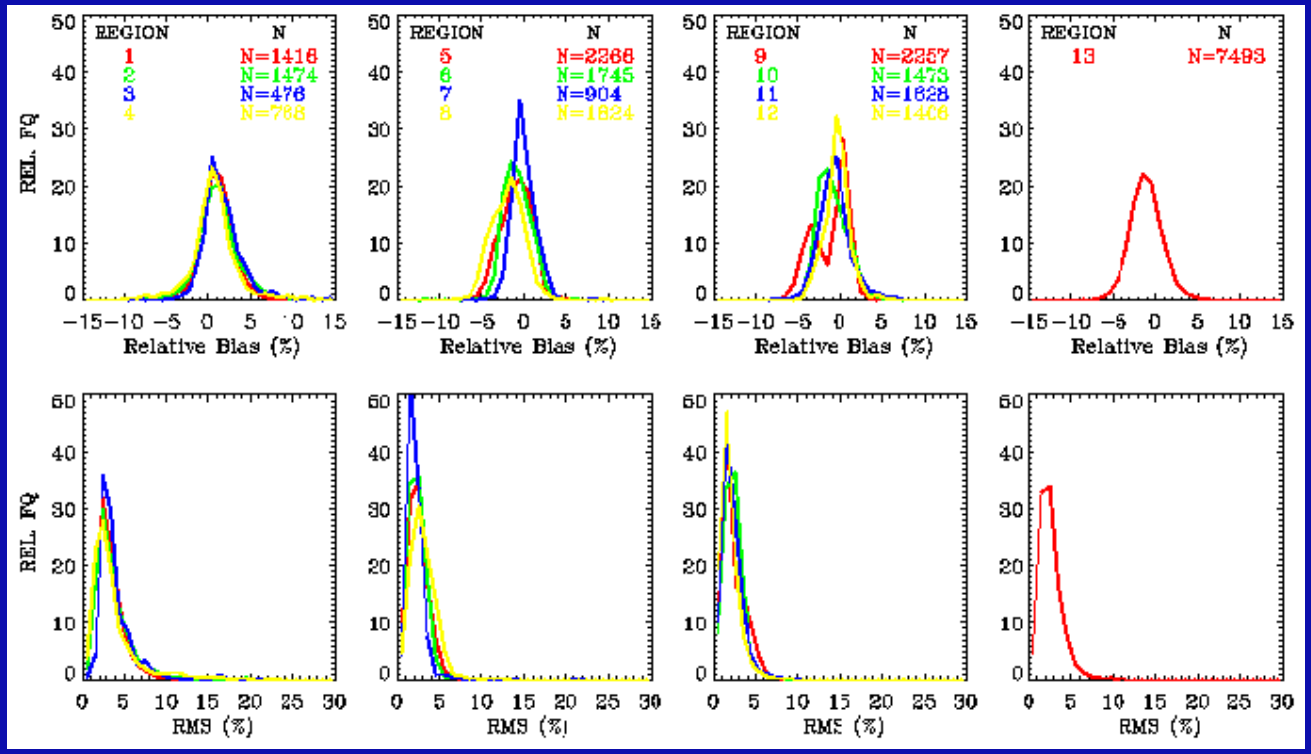
1° x 1° Regional Relative Bias and RMS Error in Land SW Radiance for DJF(2000-01)



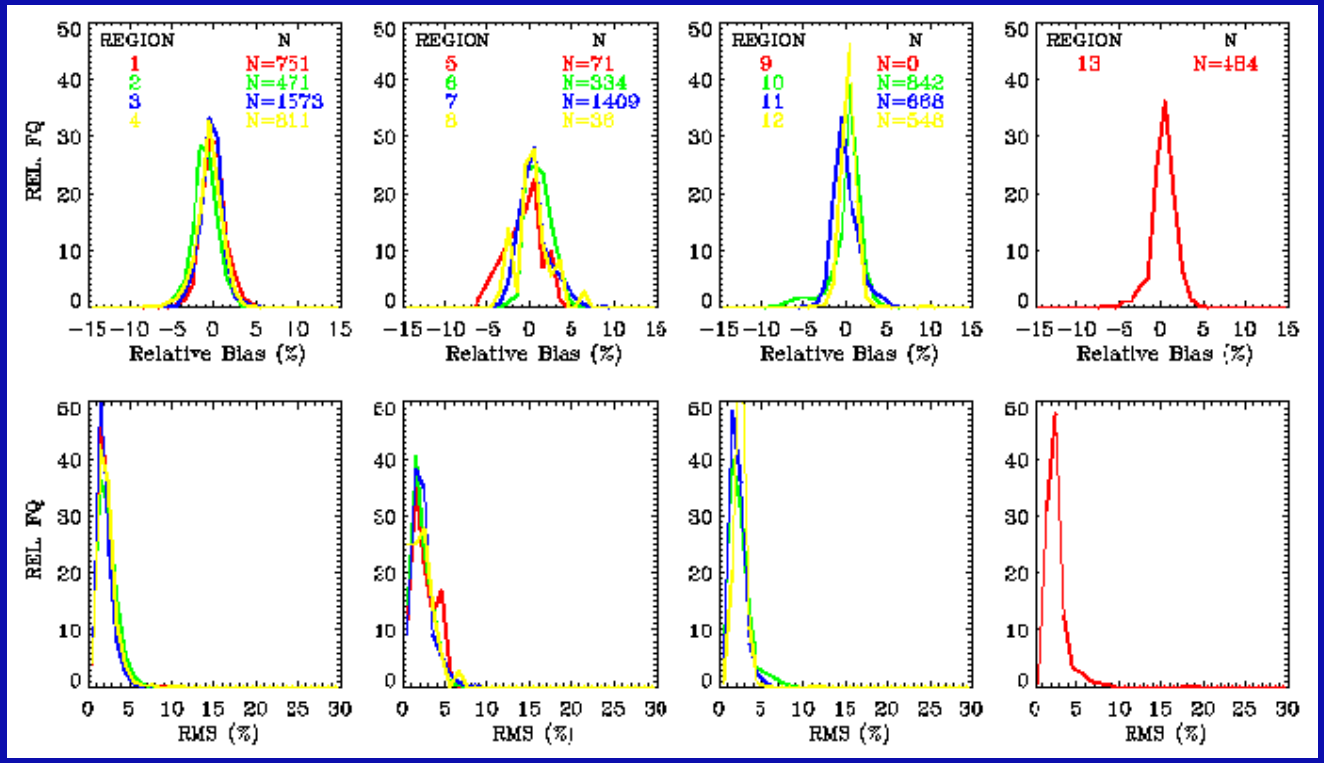
1° x 1° Regional Relative Bias and RMS Error in Ocean SW Radiance for JJA(2000)



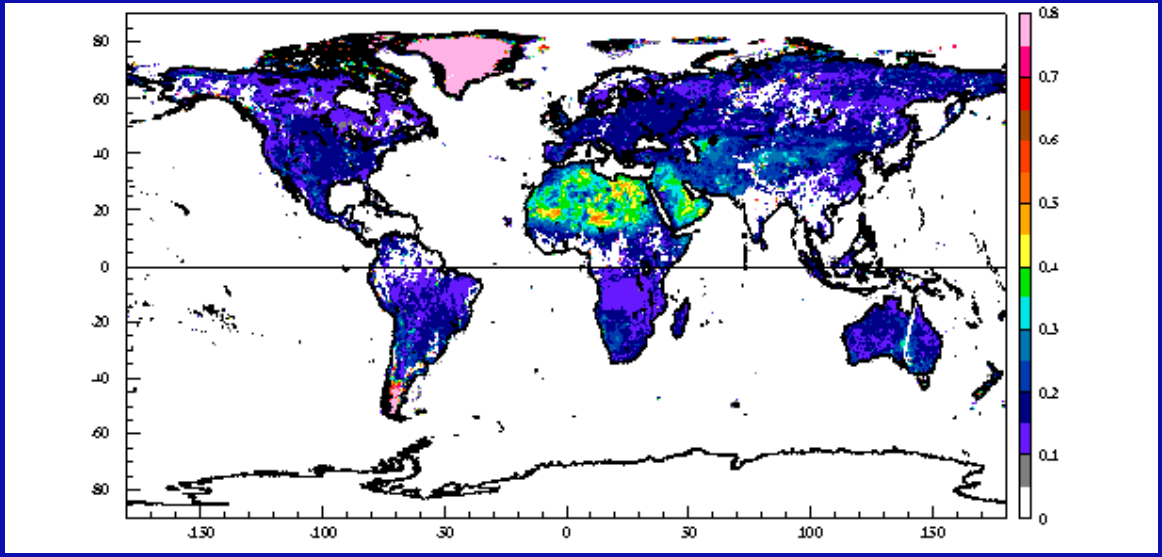
1° x 1° Regional Relative Bias and RMS Error in Ocean SW Radiance for DJF(2000-01)



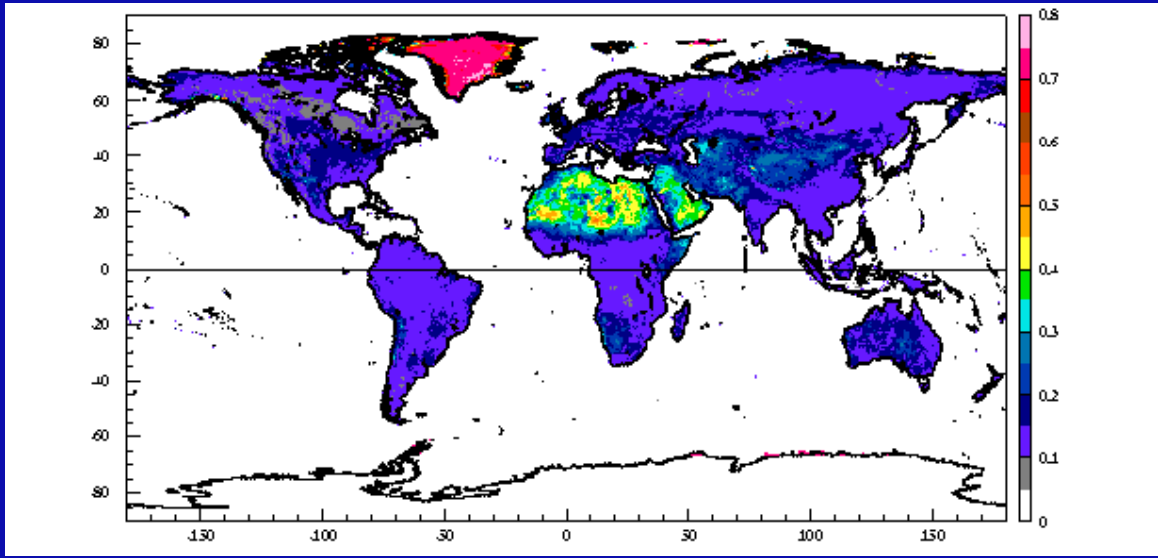
1° x 1° Regional Relative Bias and RMS Error in Land SW Radiance for JJA(2000)



Broadband DHR for MODIS/MISR for July 2001



MISR DHR



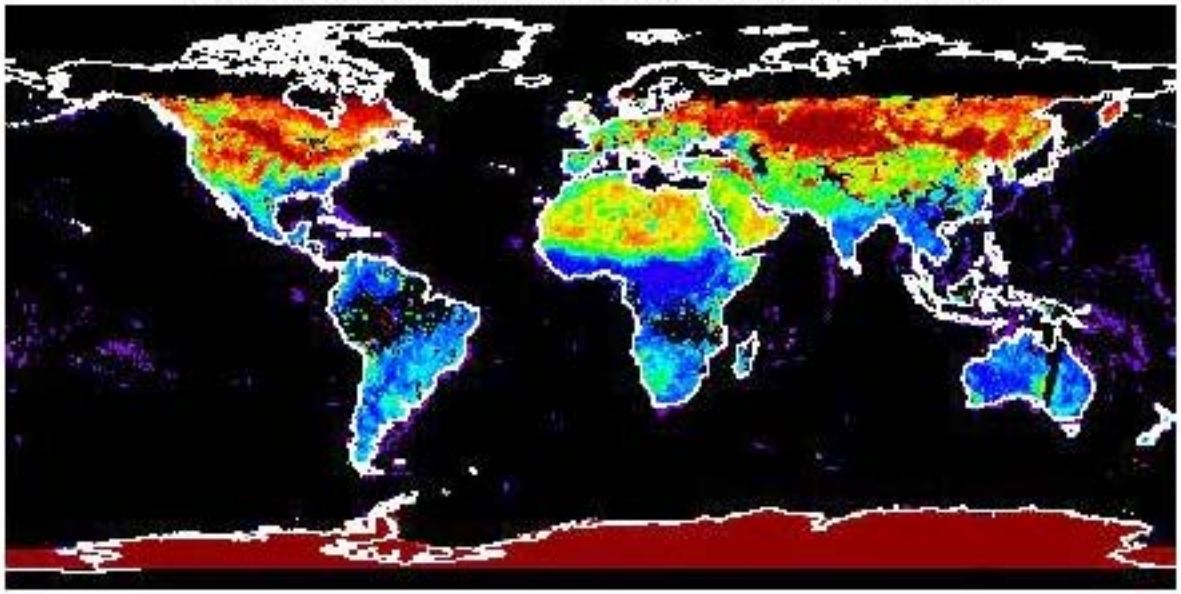
MODIS DHR

NDVI | DHRPAR | DHRSW | FPAR | LAI | DHR Nat | DHR Inf

Aerosol | Land/Surface | Radiance

DHR Shortwave approximation January 2001 F01_0006

Derived from L2 AS_LAND, LandDI IR field F03_0012, 0.5 deg res



DHR Shortwave approximation

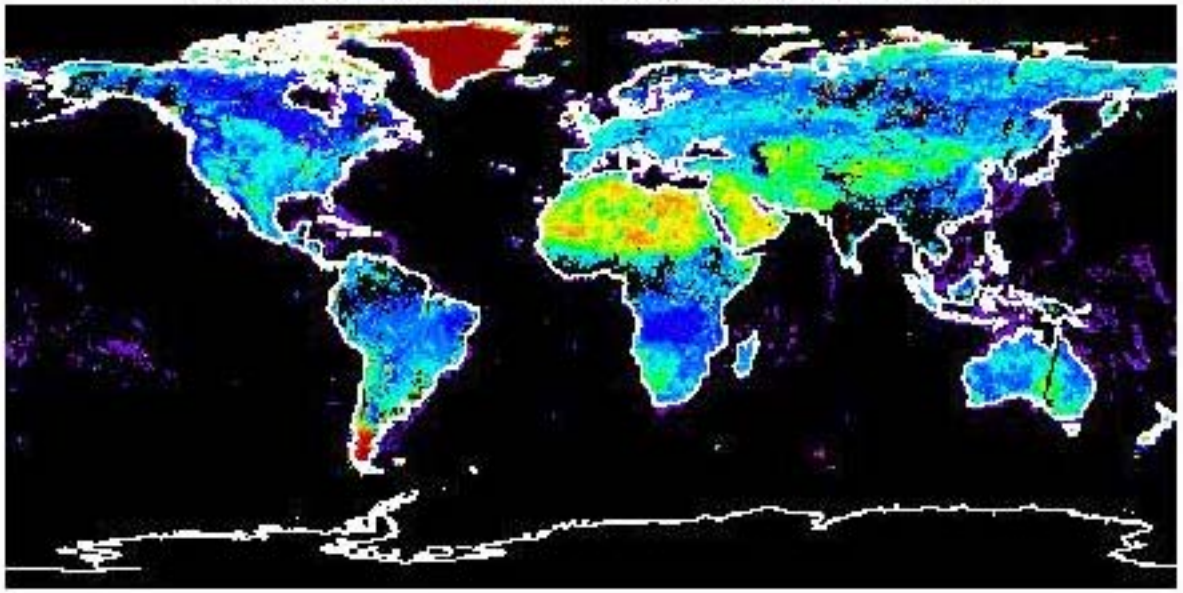
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

NDVI | DHRPAR | DHRSW | FPAR | LAI | DHR Nat | DHR Inf

Aerosol | Land/Surface | Radiance

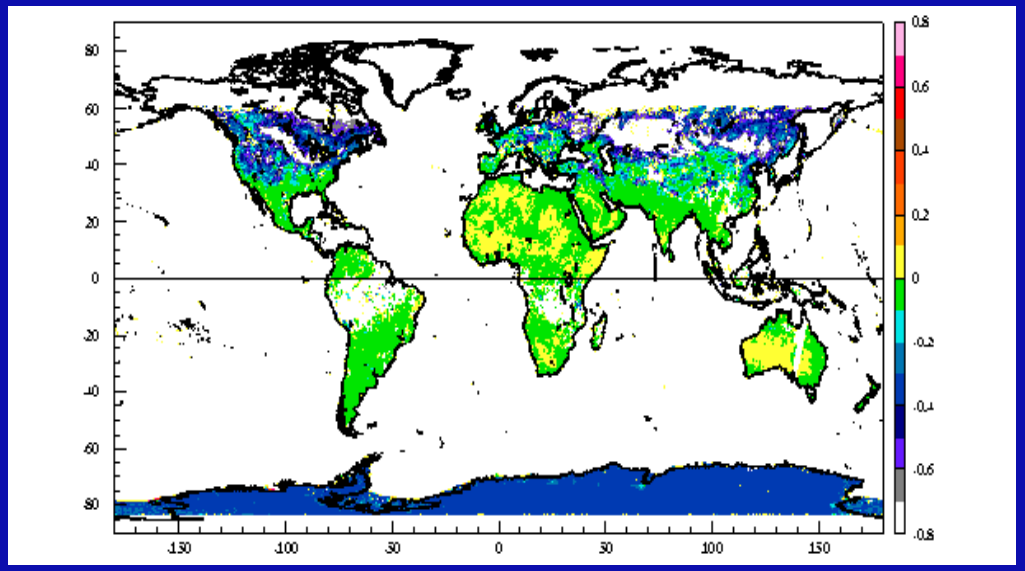
DHR Shortwave approximation July 2001 F01_0006

Derived from L2 AS_LAND, LandDI IR field F03_0012, 0.5 deg res



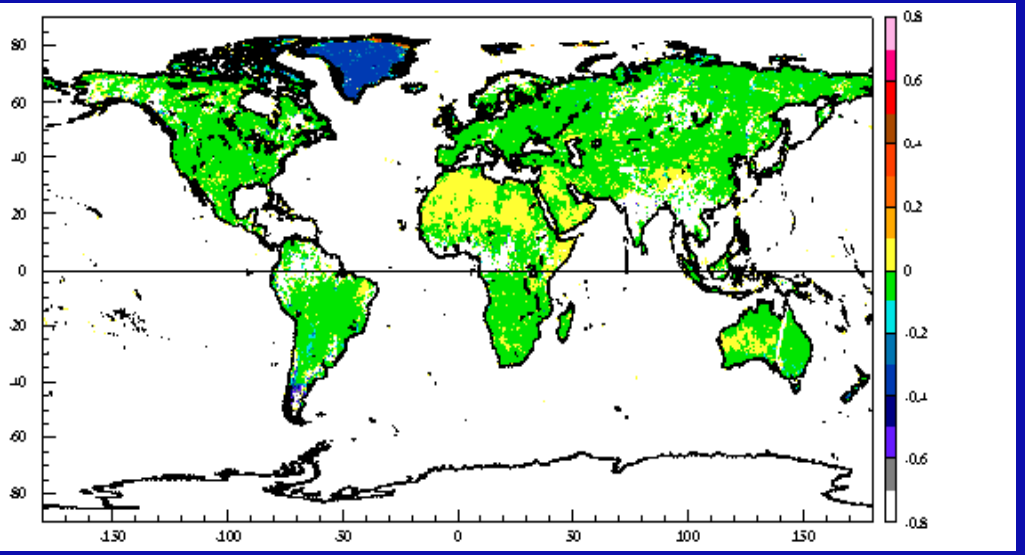
DHR Shortwave approximation

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0



Absolute ΔDHR

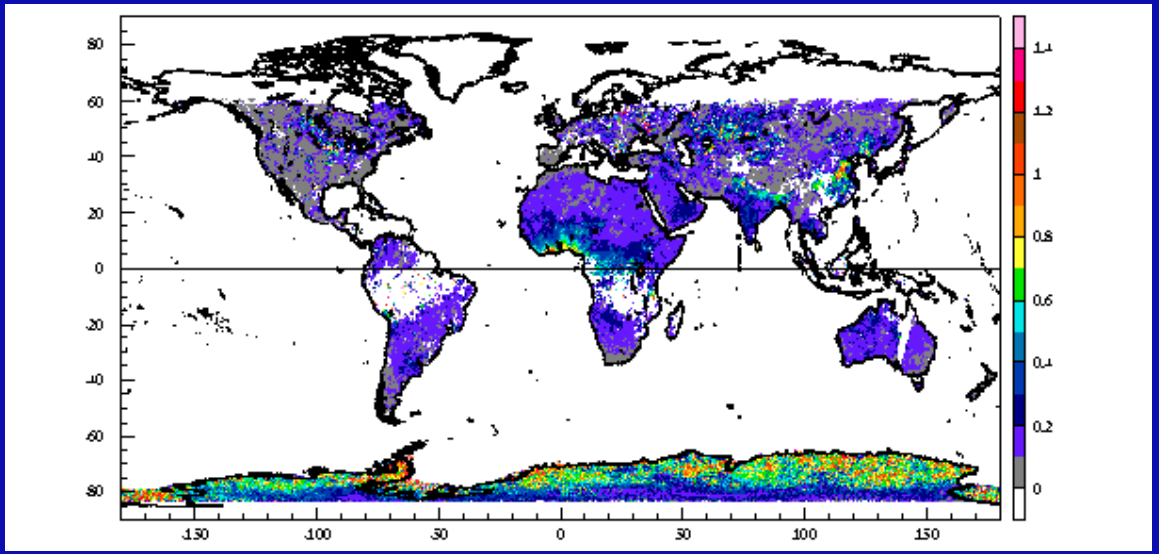
Jan 2001



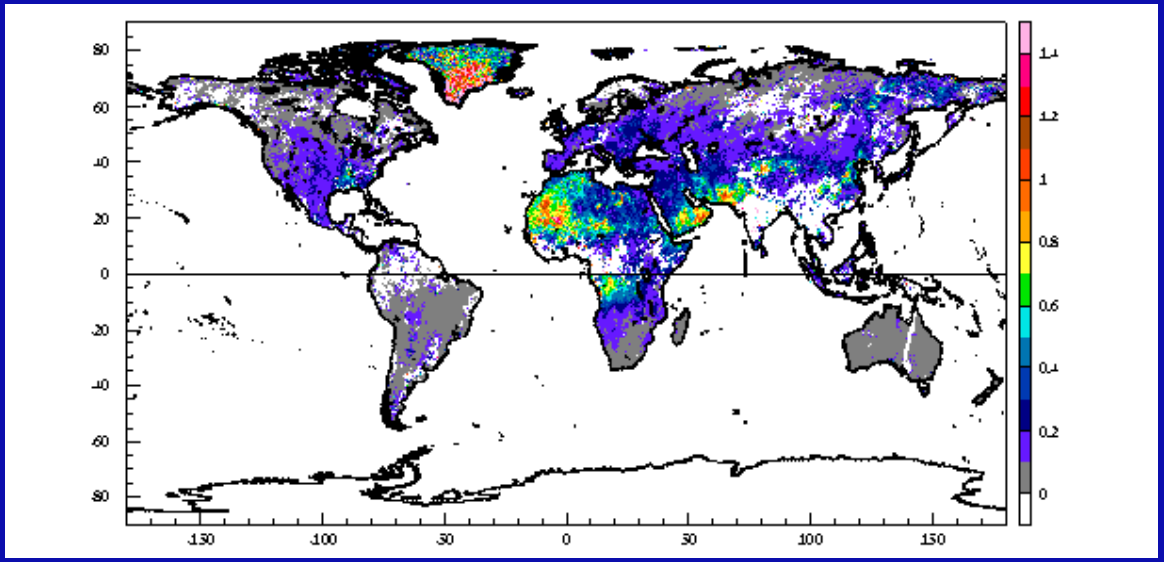
Absolute ΔDHR

Jul 2001

MISR Aerosol Optical Depth (550 nm) for Jan, Jul 2001

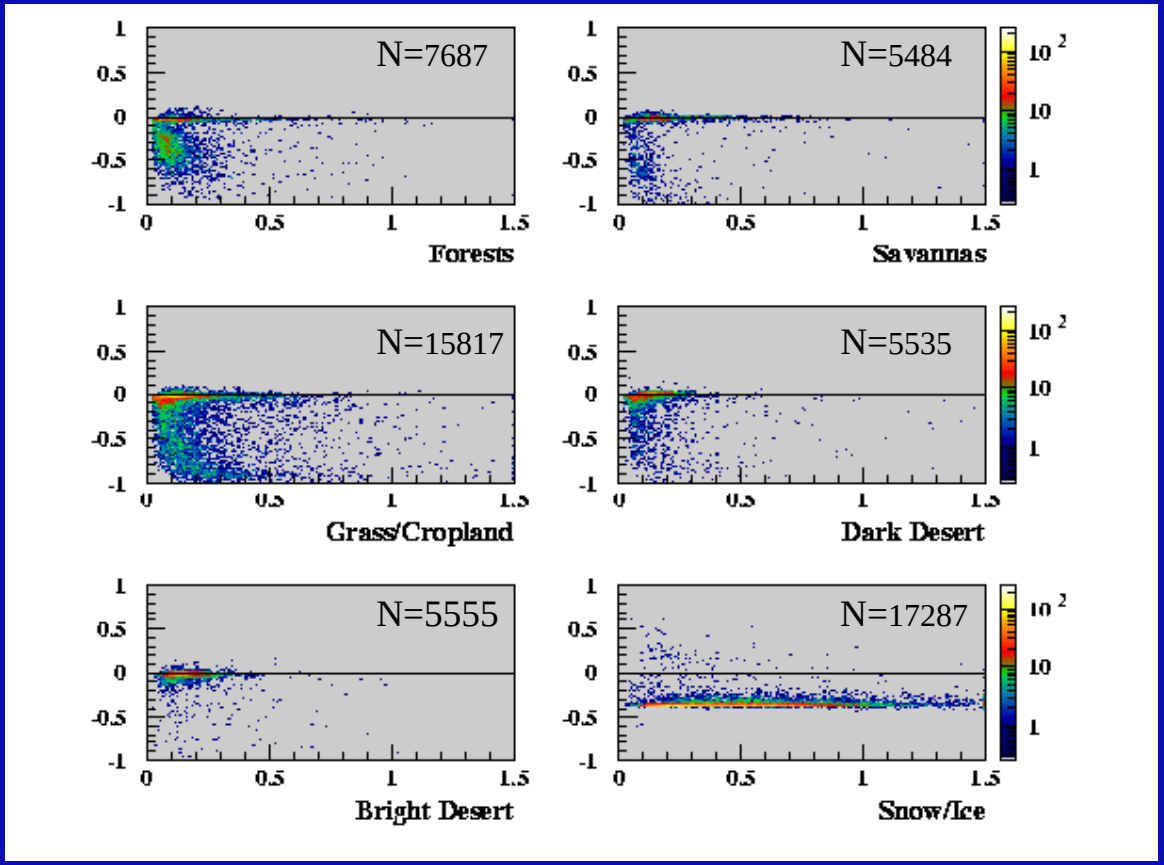


January



July

ΔDHR vs.. MISR Aerosol Optical Depth (550 nm) for January 2001



ΔDHR vs.. MISR Aerosol Optical Depth (550 nm) for July 2001